Role of MRI in the Evaluation of Adnexal Masses - A Prospective Study

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ABSTRACT

BACKGROUND

Among all the disorders of female reproductive system, adnexal masses are one of the most common disorders. The main purpose of the study was to evaluate an adnexal mass and to differentiate the mass as benign or malignant and facilitate selection of appropriate treatment algorithm. For few benign lesions, radiological follow-up is very suitable for further management and additional follow-up may not be useful when an imaging abnormality is not found.

METHODS

Our study was conducted in Osmania General Hospital and its allied hospital named Government Maternity Hospital, Hyderabad, on about 150 patients. This is an institution-based, multicentric, cross-sectional, prospective, analytical study. All clinically suspected female patients with adnexal masses referred to the Department of Radiodiagnosis were evaluated. These patients were first subjected to ultrasonography, followed by magnetic resonance imaging (MRI) (plain and contrast wherever required). MRI findings were compared with ultrasonography. These findings were compared with operative findings and histopathological findings, wherever performed.

RESULTS

In the present study, females in the age group of 21 – 40 years showed majority of pelvic lesions - 81 (54 %). Most of the pelvic masses were arising from the ovary - 102 (68 %). Majority of the adnexal lesions on MRI were benign in nature - 132 (88 %). MRI showed a sensitivity of 100 %, specificity of 97.7 %, and a positive predictive value of 83 %, & a negative predictive value of 100 %.

CONCLUSIONS

In practice, ultrasonography (USG) is the primary modality for diagnosing the pelvic mass. MRI is superior to ultrasound and can be used as problem solving technique in the assessment of pelvic mass. The multiplanar imaging capability allows accurate identification of origin of mass and characterisation of mass. This is helpful to the preoperative planning of sonographically detected mass and avoids surgery in possible cases. MRI is the technique of choice for staging, treatment planning and post treatment follow-up of pelvic malignancies.

KEYWORDS

MRI, USG, Adnexal Masses, Ovarian Masses, Board Ligament Lesions, Fallopian Tube Lesions, Cysts

BACKGROUND

Major components of adnexal region are ovary, fallopian tube, broad ligament, and associated blood supply and nerve supply. About two thirds of adnexal lesions are ovarian tumours. Among these, ovarian cancer is the deadliest of all gynaecological cancers, because of its late presentation and poor response to treatment.[1] The main purpose of radiological evaluation of an adnexal mass is to distinguish between malignant and benign diseases, which help clinician to choose appropriate treatment algorithm for the patient.

Ultrasound of pelvis is used as first imaging study in evaluating women with suspected adnexal masses, due to its easy availability, relatively cheap and high sensitivity in the detection of lesions.[2,3] But, USG of pelvis has its limitations like decreased specificity in diagnoses of benign lesions[4] which can vary from 60 % to 95 % and also has limitation of classifying as many as 20 % of adnexal masses, as indeterminate.[5,6] Main disadvantage of ultrasound is that the field of view is limited; sometimes bowel gas obscures the pelvic organs. It is possible to suspect malignancy, but definite diagnosis cannot always be made. To overcome these limitations of ultrasound, magnetic resonance imaging is much better in delineating and diagnosing the pelvic lesions.

Magnetic resonance imaging has shown promising results in pelvic imaging. MRI has advantage of better soft tissue contrast than in ultrasound. MRI T2 weighted images are much better for the soft tissue contrast and to characterise the abnormalities.[7] The T1 weighted images and fat saturated sequences are used to demonstrate the fat containing lesions like dermoid, which are difficult to diagnose on USG. The same images are also used to differentiate between haemorrhagic and fat containing lesions. MRI helps to distinguish normal anatomical structures and the pathological lesions. MRI has high sensitivity and specificity for differentiating benign pelvic lesions from malignant lesions.

Objectives
- To assess the relative role of USG and MRI in diagnoses of adnexal mass lesions and compare them with clinical outcome or operative findings.
- To study about the varied nature of adnexal mass lesions.
- To study the significance of MRI in diagnosing sonographically detected indeterminate masses.

METHODS

This is an institution-based, multicentric, cross-sectional, prospective, analytical study. 150 patients with clinically suspected adnexal masses, who presented to Department of Radiology, Osmania General Hospital and its allied hospital named, Modern Government Maternity Hospital, Hyderabad, from 2015 to 2018, were selected for this study.

All clinically suspected female patients with adnexal masses referred to the Department of Radiology, OGH / MGMH were enrolled in the study.

- These patients were first subjected to ultrasonography, followed by MRI (plain and contrast wherever required).
- MRI findings were compared with that of ultrasonography.
- These findings were compared with that of operative findings and histopathological findings wherever performed.
- USG studies were performed by using multi frequency, linear, curvilinear and transvaginal transducers on Esaote MY LAB CLASSIC
- MRI studies were performed on 1.5 Tesla electromagnet (GE company). The primary pulse sequences included T1WI and T2WI. Images were obtained with a multislice technique using a slice thickness of 3 mm, interslice gap of 6 mm, FOV of 220 – 240 mm and a matrix size of 512* 512.
- Contrast was given wherever necessary. The patient was followed up, to co-relate the findings with clinical outcome or operative findings.
- Gadolinium-enhanced MR imaging using high resolution fat-suppressed axial, coronal, sagittal T1 FSE. Gadolinium contrast (Omniscan, GE health care, 0.1 mmol / Kg body weight) was used.

Inclusion Criteria
- Clinically suspected cases of adnexal mass lesions were included.
- Adnexal mass lesions found on USG were included.

Exclusion Criteria
- All midline mass lesions were excluded.
- Patients with cardiac pacemakers, prosthetic heart valves, cochlear implants or any metallic implants were excluded.
- Claustrophobic patients have been excluded.

Histopathology
All patients who underwent surgery; operative findings with their histopathology report were obtained. The MR morphology was compared and correlated with histopathological features.

Statistical Analysis
Descriptive statistical analysis has been carried out in the present study. Diagnostic statistics such as sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV) and accuracy has been used to find the correlation of USG scan and MRI scan with final diagnosis.

Disease					
Test	Present	a	Absent	a	Total
Positive	True positive	a	False positive	c	a + c
Negative	False negative	b	True negative	d	b + d
Total	**a + b**		**c + d**		
Statistical Analysis					

The following statistics can be defined
- Sensitivity: is true positive rate, expressed as a percentage = a / a + b
- Specificity: is true negative rate, expressed as a percentage = d / c + d
- Positive predictive value: = a / a + c
- Negative predictive value: = d / b + d
- Accuracy is = a + d / a + b + c + d

RESULTS

A total of 150 patients had adnexal masses of whom 90 patients underwent surgery and the remaining cases were managed conservatively. Out of 150 patients with adnexal masses, the age group of patients varied with a wide range from 5 – 80 yrs. Most affected age group was 21 - 40 years (54 %). Others, 0 - 20 years were 42 patients (28 %), 41 - 60 years were 16 % and 61 - 80 years were 2 %. The most common clinical presentation was lower abdominal pain and lump in the lower abdomen. The patients with lower abdominal pain were 132 (88 %) out of 150 and lower abdominal lump were 48 patients i.e. 32 %. Patients with irregular cycles were 10 % and with primary amenorrhea, primary infertility, bloody vaginal discharge were 4 % each.

Among 150 patients with adnexal mass lesions assessed with USG, patients with ovarian masses were 90 i.e. 60 %, fallopian tube lesions were 8 % and broad ligament lesions were 4 %. 30 % of patients who underwent USG, anatomical lesions were inconclusive. Among 150 patients with adnexal mass lesions assessed with MRI, patients with ovarian masses were 102 i.e. 68 %, fallopian tube lesions were 11 % and broad ligament lesions were 8 %. 14 % were having uterine lesions and others were 4 %. Out of 150 patients with adnexal masses, right sided lesions were present in 42 %, left sided lesions were present in 40 % and bilateral lesions were present in 18 % of these patients. Evaluating consistency with USG, out of 150 patients, majority were cystic accounting for 50 %, solid lesions were 18 %, complex lesions were 32 %. In MRI analysis of consistency of adnexal masses, cystic lesions were predominant accounting for 56 %, solid lesions were 18 % and complex lesions were present in 26 % of these patients.

Out of 150 patients analysed on USG, various spectrum type of lesions were: simple follicular cyst 8 %, haemorrhagic cyst 20 %, endometriotic cyst 8 %, serous cystadenocarcinoma 2 %, ovarian torsion 4 %, hydrosalpinx 6 %, ovarian dermoid cyst 2 %, haematosalpinx 2 %, serous cystadenoma 4 %, mucinous cystadenoma 4 %, broad ligament fibroid 2 %, thecal lutein cysts 4 %, ectopic

pregnancy 2 %, ovarian stromal oedema 2 %, broad ligament haematoma 2 %, indeterminate 28 % and most common lesion type was indeterminate.

In MRI analysis of various types of lesions the most common lesion was haemorrhagic cyst 14 %, other spectrum of lesions were haemorrhagic cyst 14 %, subserosal fibroid 10 %, haematosalpinx 10 %, endometriotic cyst 8 %, ovarian torsion 4 %, pyosalpinx 4 %, ovarian dermoid cyst 6 %, hydrosalpinx 6 %, serous cystadenocarcinoma 4 %, ectopic pelvic kidney 4 %, paraovarian cyst 6 %, mucinous cystadenocarcinoma 2 %, congenital uterine anomalies 6 %, dysgerminoma 4 %, tubo-ovarian mass 2 %, thecal lutein cyst 4 %, mucinous cystadenoma 4 %, serous cystadenoma 4 %, ovarian stromal oedema 2 %, broad ligament haematoma 2 %, endodermal sinus tumour 2 %, and inconclusive 4 %.

In USG evaluation, out of 150 patients, majority were benign lesions. They were present in 129 patients i.e. 86 % and malignant lesions were present in 21 patients i.e. 14 %. On evaluation with MRI, majority of patients had benign lesions. Out of 150 patients, 132 patients i.e. 88 % had benign lesions and 12 % patients had malignant lesions. In the 150 cases studied, 60 cases were managed conservatively. Remaining 90 cases were operated and sent for histopathology, final diagnosis of these cases was correlated with USG and MRI, their sensitivity and specificity are shown in as follows.

Majority of the patients were of 21 – 40 yrs. age group (54 %). Majority of patients presented with lower abdominal pain (88 %), 32 % of patients had lower abdominal lump. Majority of the lesions on USG and MRI were ovarian in origin (60 %) and (68 %) respectively. Majority of adnexal lesions were on right side 63 (42 %) on both USG and MRI. Most of the lesions were cystic on both USG (50 %) and MRI (56 %). Majority of the adnexal lesions on USG (86 %) and MRI (88 %) were benign in nature. Majority of adnexal lesions on USG were indeterminate 42 (28 %). Majority of adnexal lesions on MRI were haemorrhagic cyst (14 %)

Final Diagnosis on Pathology / USG	Positive for Malignancy	Negative for Malignancy	Total
Positive for malignancy	12 (TP)	6 (FP)	18
Negative for malignancy	3 (FN)	129 (TN)	132
Total	**15**	**135**	**150**
Table 1. Validity of USG in the Diagnosis of Adnexal Masses			

Sensitivity = (TP / TP + FN) X 100 = 80 %
Specificity = (TN / TN + FP) X 100 = 95.5 %
Positive predictive value = (TP / TP + FP) x 100 = 66 %
Negative predictive value = (TN / TN + FN) x 100 = 97 %.

Final Diagnosis on Pathology / MRI	Positive for Malignancy	Negative for Malignancy	Total
Positive for malignancy	5 (TP)	1 (FP)	6
Negative for malignancy	0 (FN)	44 (TN)	44
Total	**5**	**45**	**50**
Table 2. Validity of MRI in the Diagnosis of Adnexal Masses (N = 150)			

Sensitivity = (TP / TP + FN) X 100 = 100 %
Specificity = (TN / TN + FP) X 100 = 97.7 %
Positive predictive value = (TP / TP + FP) x 100 = 83 %
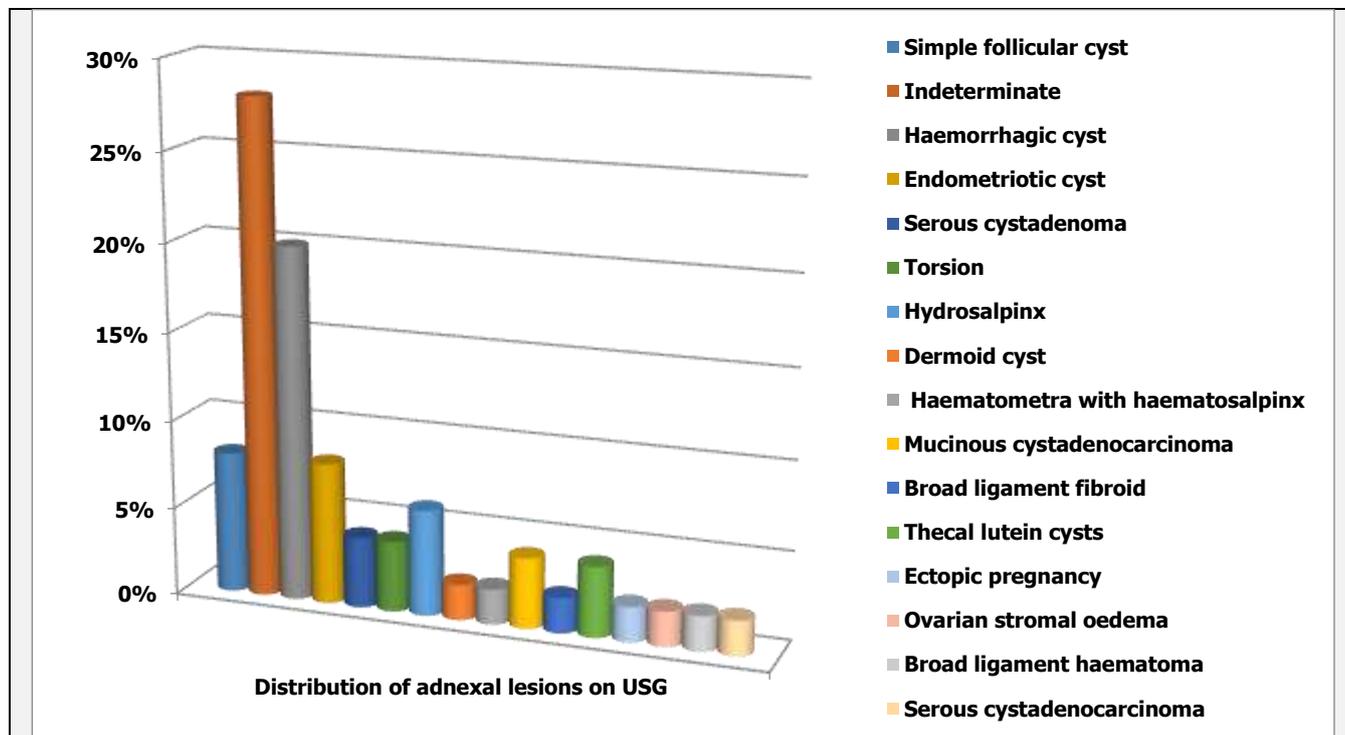Negative predictive value = (TN / TN + FN) x 100 = 100 %

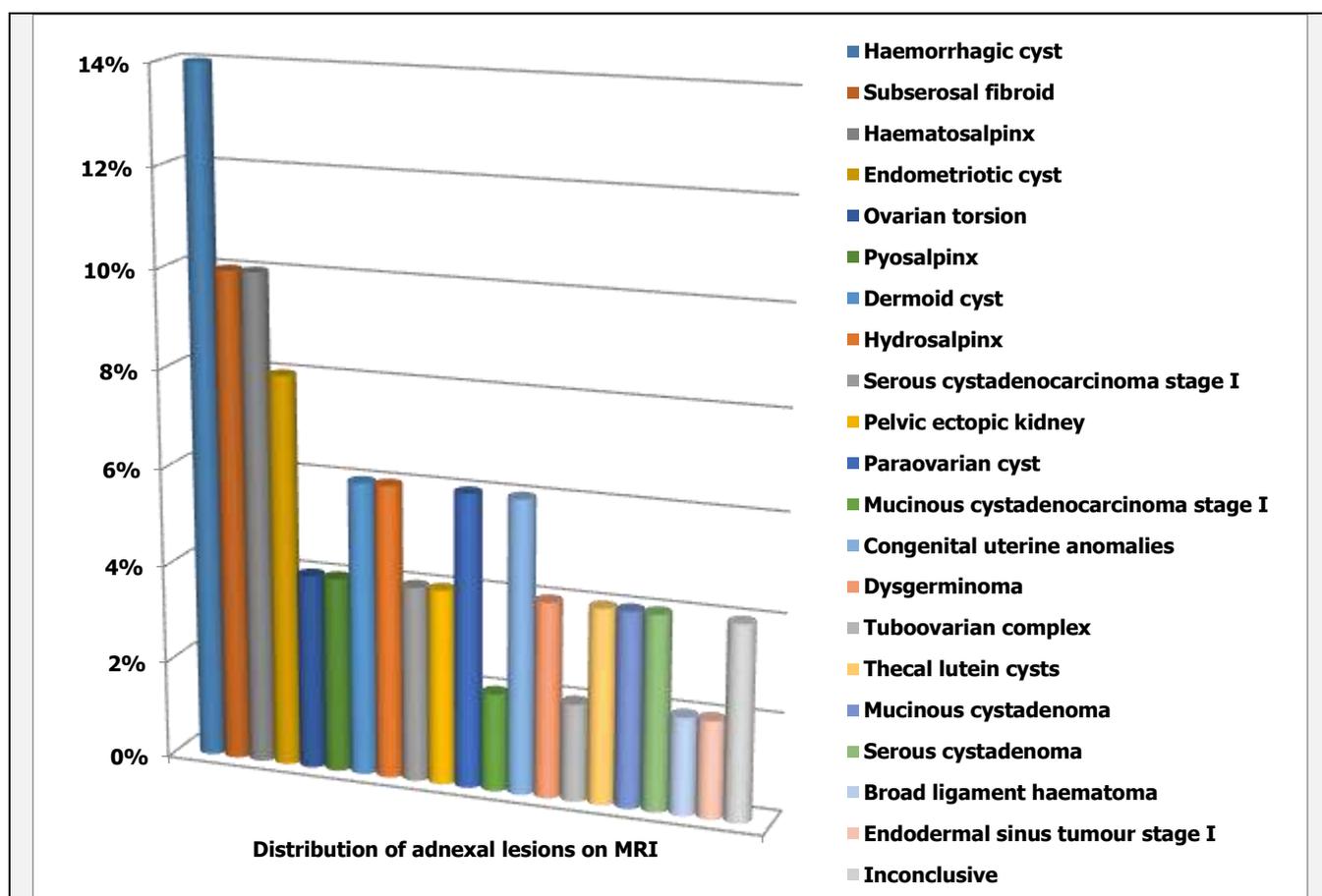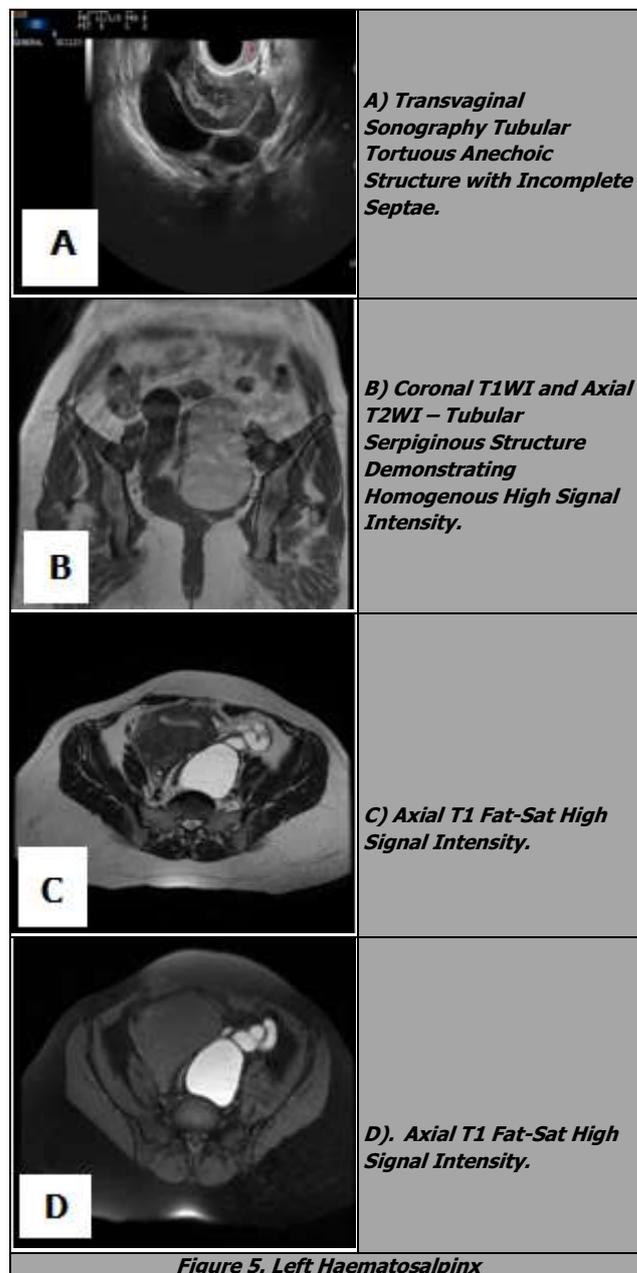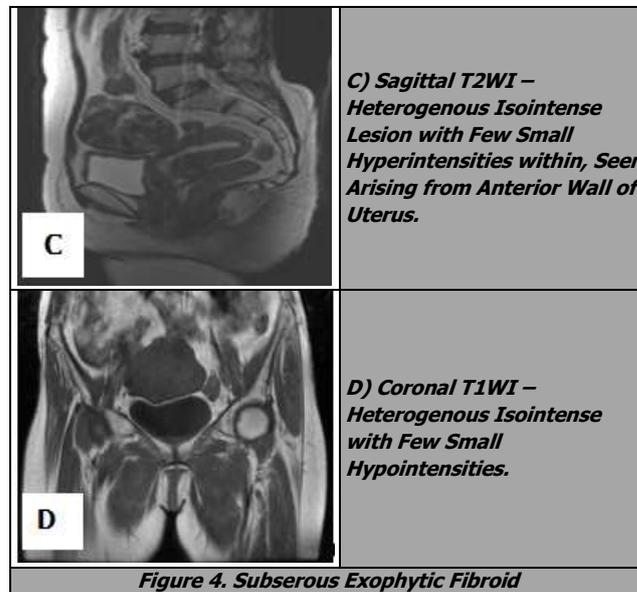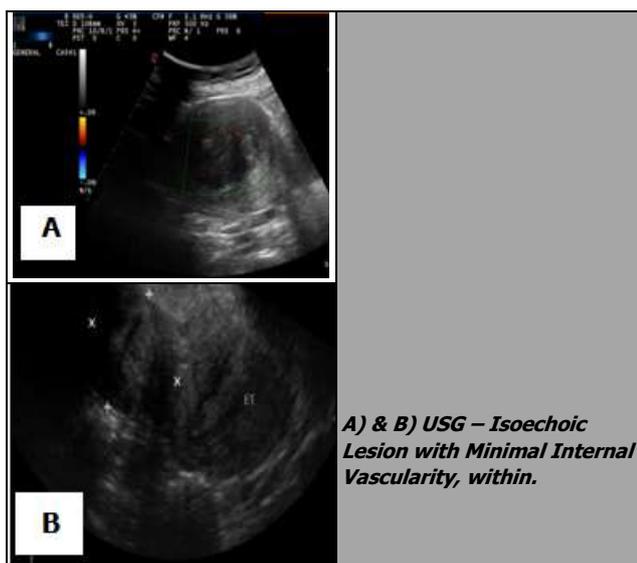**Figure 1. Distribution of Types of Adnexal Lesions on USG**

Figure 2. Distribution of Types of Adnexal Lesions on MRI

A) USG – Heterogenous Nondependent Hyper Echogenicity and Adjacent Hypoechogenecity.

B) Sagittal T2WI.

C) Axial T1WI Demonstrating Heterogenous Nondependent Hyperintensity with Fat-Fluid Level with Heterogenous Hyperintense Nodule.

D) Axial T1W Fat-Sat Suppression of Hyperintense Signal of Non-Dependent Fat and Dermoid Plug.

Figure 3. Left Ovarian Dermoid CYST

A) & B) USG – Isoechoic Lesion with Minimal Internal Vascularity, within.

C) Sagittal T2WI – Heterogenous Isointense Lesion with Few Small Hyperintensities within, Seen Arising from Anterior Wall of Uterus.

D) Coronal T1WI – Heterogenous Isointense with Few Small Hypointensities.

Figure 4. Subserous Exophytic Fibroid

A) Transvaginal Sonography Tubular Tortuous Anechoic Structure with Incomplete Septae.

B) Coronal T1WI and Axial T2WI – Tubular Serpiginous Structure Demonstrating Homogenous High Signal Intensity.

C) Axial T1 Fat-Sat High Signal Intensity.

D). Axial T1 Fat-Sat High Signal Intensity.

Figure 5. Left Haematosalpinx

DISCUSSION

The present study was conducted in 150 patients with adnexal masses and they were subjected to USG and MRI. Among 150 cases, 90 cases were operated and the final diagnosis was confirmed by histopathological examination (HPE), remaining cases were managed conservatively.

Most common age group having adnexal masses was 21 - 40 years and mean age was 30 years. Mean age group in a study done by Al-Shukri et al.[8] was 28 years. The present study was comparable with the above-mentioned study. Adnexal masses were most commonly found in the reproductive age group.

The most common presenting complaints of patients with adnexal masses were lower abdominal pain (88 %) and lump in the lower abdomen (32 %). When compared to other study done by Guzel Al et al. the initial compliant of the cases were abdominal pain in 77.5 % of the cases, 20 % of the patients had vaginal bleeding and 12.5 % of the patients were asymptomatic.[9]

Though radiological evaluation by ultrasound is less useful for ascertaining the origin of the mass, it can be important first step in identifying an adnexal mass, but accurate tissue characterisation was excellent for MRI.[4]

In the present study left sided lesions were found in 40 %, right sided lesions were found in 42 % and bilateral lesions were found in 8 % of the total study group. Study done by Padilla LA et al.[10] had found forty-nine left adnexal and 99 right adnexal masses during surgery. As the sample size in our study was low when compared to the above-mentioned study; there was a little variation when compared to the above study.

In a study done by Prabha T et al.[11] both USG and MRI were done in 150 female patients with clinical suspicion of pelvic mass. On USG they found that, cystic lesions was present in 0 % of the cases and solid lesions were found in 66 % of the patients and complex lesions are found in 34 % of cases. On MRI they found 27.08 % of cystic lesions, 37.5 % of solid lesions and 31.25 % of patients had complex lesions. In 6 patients MRI was not done.

In the present study our findings on USG were 50 % cystic, 18 % solid masses and 32 % were complex lesions. On MRI cystic lesions were found in 28 % of patients, solid masses in 18 % and 26 % had complex lesions.

The most common origin of adnexal mass was ovary as quoted by Adusumilli et al.[4] (56 %), comparable to our study which was 68 %. An excellent correlation was found between MRI findings and the final pathological diagnosis of a mass. Thus, MRI plays an important role in evaluation of adnexal mass, before advising surgery for a patient, which might be unnecessary.

Our study diagnosed an adnexal mass as a pedunculated uterine fibroid with same accuracy as to those reported in prior MR studies.[12,13] By recognising the stalk of the fibroid and finding normal ovaries separately, we confirmed the diagnosis of a fibroid on MRI, without confusing it with ovarian fibrous tumours.

In the present study, we found that MR imaging in the detection and characterisation of adnexal masses had 100 % sensitivity and 97.7 % specificity. This signifies that MR imaging is highly accurate in the characterisation of adnexal mass lesions. Accuracy of MR imaging in the detection and characterisation of adnexal mass lesions with a sensitivity of 95 % and specificity of 88 % was depicted in a study conducted by Aslam Sohaib et al.[14]

A meta-analysis done by Kinkel K et al. showed that contrast-enhanced MRI had sensitivity and specificity of 100 % and 94 %, respectively, in diagnosis of malignancy[4] in an indeterminate adnexal mass. MRI is an excellent modality in providing confident diagnosis of many common benign adnexal lesions.[15] Therefore, women with indeterminate pelvic masses on ultrasound but clinically have a low risk of malignancy are most likely to benefit from MRI.[14]

The MRI sensitivity and specificity for malignancy were 98 % and 93 %, respectively in a study conducted by Guerra A et al.[16] which is comparable with our present study, where sensitivity and specificity are 100 % and 97.7 % respectively.

The sensitivity of grayscale USG in adnexal masses in a study conducted by Madan MK et al.[17] was 92.5 %, comparable to our study with 80 %.

The results of the present study are reliable in comparing the values of different studies as mentioned with slight variation; as the (N) no for the present study was less in comparison to other studies.

On a comparative study of most common origin of adnexal masses by MRI, according to author Adusumilli et al. (N = 95), 52 % showed ovary as most common origin of pelvic mass whereas in our study 68 % showed ovary as most common origin of pelvic mass.

On a comparative study of sensitivity & specificity of MRI to characterise malignant nature of adnexal masses, Sohaib et al. (N = 104) study showed MRI sensitivity was 95 % and specificity was 88 %, Guerra et al. (N = 199) study showed 98 % MRI sensitivity and 93 % specificity. In our study, MRI sensitivity was 100 % and specificity was 97.7 %.

Author	USG Sensitivity
Madan Mk et al. (N = 74)	92.5 %
Present study (N = 150)	80 %
Comparative Study of Sensitivity of Adnexal Masses on Conventional Gray Scale USG	
Saimahafeez et al. (N = 104)	90 %
Present study (N = 150)	80 %
Comparative study of Sensitivity of USG in Characterisation of Ovarian Masses	
Table 3	

CONCLUSIONS

To characterise adnexal masses, first step is to find its site and second step is tissue characterization both of which are well delineated by MRI. Routinely, USG is the primary modality for diagnosing the pelvic mass; however, MRI can be used as problem solving technique in the assessment of pelvic mass. MRI plays an important and essential role in staging of malignancy, detection of disease, recurrence and appropriate treatment selection.

Disclosure forms provided by the authors are available with the full text of this article at jebmh.com.

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